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Vannah River Company
Alken, SC 29808



June 10, 1997

PEC-SSD-970065

Mr. David Will
Mason & Hanger Corporation

UNIQUE DOCUMENT # SAC200124330000

Dear Mr. Will:

Subject: Preliminary Hazard Analysis for Surplus Pit Storage Facility Upgrade Project (u)

Attached is the draft Preliminary Hazard Analysis (PHA) document for the surplus pit storage facility upgrade project. The PHA provides a comprehensive list of hazardous events that impact the public, worker, facility, and environment. The frequency and consequence level (high, moderate, low) of the identified hazardous events was determined along with the risk bin. To provide a truly unmitigated consequence, no controls were credited in the evaluations, including not giving credit for the pit cladding, storage drums, or for the facility structure. The reason for this approach is to provide a good technical basis for the level of control required (i.e., safety class, safety significant, important to safety). These results should not be used to evaluate past or current operations at Pantex, as there are controls in place for which this analysis does not take credit.

The identification of the preventative and mitigative structures, systems, and components (SSCs), or Administrative Controls that are to be credited is in process. We will issue a separate safety classification document once the preliminary selection of controls is completed. We will be working with Pantex people to select the controls. The frequency and consequences of the events with controls will be evaluated and included in the classification document.

Please review the attached draft PHA and provide written comments to me. After all comments have been received I will contact you as to the best way to respond. To meet your schedule needs, it may be advantageous to have a meeting where all the commentators can be present and resolution can be reached. This is especially helpful in reaching quick resolution when there are multiple comments on one topic or where commentators have varying viewpoints.

Sincerely,

Larry Eppler
Larry Eppler

cc: P. Stewart, MHC

WITH ATTACHMENTS/ENCL
DEPARTMENT: ENERGY SAFETY
CLASSIFICATION REVIEW
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AUTHORITY: SAC CLASSIFIED TO: UNCLASSIFIED
NAME: S. K. Mitchell
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Classified By: J. C. Phillips
(Name/Personal Identifier & Title) Class. Analyst
Derived From: 49400 Rev 7 9/94
(Guide/Source Document & Source Date)

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FOR
THE SURPLUS PIT STORAGE FACILITY
UPGRADE AT CONCEPTUAL DESIGN PHASE (U)

June 1997

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RO: S. M. PATEL

Date 6-10-97

Patent Status

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Westinghouse Savannah River Company
Project Engineering and Construction Division
Aiken, SC 29808



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Key Words: Pit
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Storage
Hazards Analysis

Retention: Lifetime

PRELIMINARY HAZARDS ANALYSIS
FOR
THE SURPLUS PIT STORAGE FACILITY
UPGRADE AT CONCEPTUAL DESIGN PHASE (U)

June 1997

K. R. B. Menger

Westinghouse Savannah River Company
Project Engineering and Construction Division
Aiken, SC 29808



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PROJECT: BUILDING 12-66 SURPLUS PIT STORAGE FACILITY

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PIT STORAGE FACILITY UPGRADE AT CONCEPTUAL
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LIST OF ACRONYMS AND ABBREVIATIONS

A	Anticipated
AGV	Automated Guided Vehicle
ARF	Airborne Release Fraction
BIO	Basis for Interim Operation
CEDE	Committed Effective Dose Equivalent
DBA	Design Basis Accident
DOT	Department of Transportation
EPA	Environmental Protection Agency
EU	Extremely Unlikely
HA	Hazards Analysis
HAD	Hazard Assessment Document
HEPA	High Efficiency Particulate Air filter
HVAC	Heating, Ventilation, and Air Conditioning
MAR	Material-at-Risk
MEOI	Maximum Exposed Off-Site Individual
MEOW	Maximum Exposed On-Site Worker
MORT	Management Oversight Risk Tree
NFPA	National Fire Protection Association
NPH	Natural Phenomena Hazard
OSHA	Occupational Safety and Health Act
OSRs	Operational Safety Requirements
PHA	Preliminary Hazards Analysis
RCRA	Resource Conservation and Recovery Act
RF	Respirable Fraction
SAR	Safety Analysis Report
SARP	Safety Analysis Report for Packaging
SPSF	Surplus Pit Storage Facility
SSCs	Structures, Systems, and Components
U	Unlikely
UPS	Uninterruptible Power Supply
WSRC	Westinghouse Savannah River Company

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EXECUTIVE SUMMARY

A comprehensive review of hazards associated with the proposed design and operation of the Surplus Pit Storage Facility, Building 12-66 (SPSF), was performed to identify potential hazardous event scenarios. The review is based upon initial design information given in Reference 1, Preliminary Design Report, Surplus Pit Storage Upgrade Building 12-66. To determine the risk of hazardous events, a Preliminary Hazards Analysis was performed.

The offsite dose to the maximally exposed individual at the site boundary from some unmitigated events exceeds the Evaluation Guidelines. Based on the analyses presented in this report, structures, systems or components (SSCs) will be required to perform a Safety Class function to mitigate or reduce the frequency of these events.

Also, there are events that exceed the onsite radiological Evaluation Guidelines. Based on the analyses presented in this report, structures, systems or components (SSCs) will be required to perform a Safety Significant or Important to Safety function to mitigate or reduce the frequency of these events. These events will be evaluated by a Structure and System Classification engineer for appropriate Defense in Depth features.

No chemicals have been identified for use in the Surplus Pit Storage Facility (Ref. 1). Chemicals for use in other facilities could, however, be delivered to the Loading Dock which serves a number of functions, one of which will be the receiving of pit containers by the SPSF. Considering the shared functions of the dock, these chemicals are treated in this analysis as transient and are evaluated only to the extent that they could be initiators for events which could impact the SPSF radiological inventory. Hazards associated with the release of these chemicals are assumed to have been evaluated in other documents. There is no hazardous chemical release consequence concern associated with the SPSF operations.

Other items containing small quantities of radiological material could be delivered to the loading dock as well. These materials will be considered in the same way as chemicals, i.e., they are considered only as potential initiators for events which could impact the SPSF radiological inventory or its personnel.

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1. INTRODUCTION

The purpose of this Preliminary Hazards Analysis (PHA) is to identify and assess potential hazards associated with the operations of the Building 12-66 Surplus Pit Storage Facility. This PHA covers the pit storage room as well as the associated support rooms and equipment.

The Hazards Analysis is the basis for preliminary identification of Safety Class Structures, Systems, and Components (SSCs) and administrative controls to protect the offsite public, and the basis for final identification of safety significant and important to safety Structures, Systems, and Components (SSCs) and administrative controls to protect the onsite worker and protect the facility from damage. A Design Basis Accident (DBA) analysis, performed using the results of this HA, will be the basis for final identification of safety class SSCs and administrative controls to protect the offsite public.

Since modifications to Building 12-66 are at the conceptual design phase at the time this report is being prepared, this analysis will be a Preliminary Hazards Analysis. This PHA will be used for identifying and assessing potential hazards and specifying functional attributes of safety systems, structures, and components during the next design phase. Continuous coordination between the facility design process and the facility safety analysis process is necessary to ensure that all functional requirements that could impact design are identified.

1.1 SURPLUS PIT STORAGE FACILITY DESCRIPTION

Building 12-66 is located in the south end of the Material Access Area of Zone 12 within the Protected Area of the Pantex Plant and is currently in use as a weapon components parts warehouse. A design is being developed for the purpose of modifying Building 12-66 to provide a facility that is safe, secure, and equipped for long-term storage of surplus pits which are to be relocated from Zone 4 (Ref. 1). Remote handling capabilities (using an automated guided vehicle or "AGV") will be provided for container storage, retrieval, and inventory functions to minimize potential for radiation exposure to operators. This remote handling process is known as "Stage-Right" and is currently being used in Zone 4 (Ref. 2).

The Surplus Pit Storage Facility consists of the Pit Storage Room, i.e., the 12-66 building, an interlock at the southeast corner of the pit storage room, a control room located in the southeast corner of Building 12-82 (adjacent to and east of 12-66), a loading dock, and an equipment room which houses such equipment as HVAC equipment and electrical breakers (see Figure 1).

Building 12-66 is a single story, tornado resistant, concrete facility. It has dimensions of approximately 100 feet by 200 feet, and has 20 foot ceilings. The exterior walls of the Building are constructed of reinforced concrete one foot thick. The equipment room, attached to Building 12-66 at the north end, and the interlock are of similar construction. The roof for these three rooms is of construction similar to the walls.

The loading dock will house the battery charging station and could house the pallet turner. An alternate location for the pallet turner may be the interlock. (This alternate location will not create any hazards different than those which would exist with the pallet turner located on the

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Criticality

Building design (includes such features as poisons, or dividing walls) will allow storage of all 12,044 containers such that the array in Building 12-66 will remain sufficiently sub-critical under normal conditions.

The building design will allow stacking of the pallets in any combination (provided they are stacked in normal storage locations) with the array remaining sufficiently sub-critical.

A criticality in the Pit Storage Room is assumed to be possible as the result of an event which causes the array of pallets to be disrupted such that a number of the pallets topple and fall to the floor. The initiator for this event could be an earthquake, a forklift collision (from equipment failure or human error), or pallet failure.

A criticality on the Loading Dock or in the Interlock is not possible, given the limited number of pit containers on the dock. The maximum number of pallets which may be physically located on the dock at any given time is six (36 pits). The maximum number of pallets which may be physically located in the Interlock at any given time is one (6 pits) .

All criticality assumptions will be verified in the criticality analysis.

Fire

The type and form of material contained in a pit, and pit design preclude spontaneous combustion involving pyrophoric material (Pu-239). The material is assumed to undergo oxidation before ignition would occur.

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2. PRELIMINARY HAZARDS ANALYSIS

This section describes the Preliminary Hazards Analysis (PHA) performed for the Building 12-66 Surplus Pit Storage Facility. The PHA is the initial analytical effort and systematically presents an analysis of potential process-related, natural phenomena, and external hazards that can affect the public, the workers, the environment, and the facility due to single or multiple failures. This analysis considers the potential for both equipment failure and human error.

The PHA provides a thorough, predominantly qualitative evaluation of the spectrum of risks to the public, the workers, the facility, and the environment due to accidents involving the identified hazards. It consists of two basic analytical activities: Hazard Identification and Hazard Evaluation. DOE-STD-3009-94 (Ref. 3) requires that the hazards analysis comprehensively identify potential events, event initiators, and dominant scenarios; estimate their frequencies and consequences; identify prevention and mitigation features; and present the results in terms of relative risk. Estimates of consequences and frequencies are performed in the hazards analysis such that attention is focused on those scenarios that are of greatest concern (i.e., highest risk).

2.1 PRELIMINARY HAZARDS ANALYSIS METHODOLOGY

This section presents the hazards analysis methodology that is used to identify and characterize hazards and to perform a systematic evaluation of postulated hazardous event scenarios. The results of the preliminary hazards analysis are presented in Section 2.2.

2.1.1 Hazard Identification

Hazard Identification is a comprehensive, systematic process by which all known hazards (hazardous materials and energy) associated with the facility are identified, recorded, and screened by a team of individuals representing the stakeholder organizations. The Hazards Analysis team is typically represented by such functions as safety documentation projects, hazard and accident analyses, risk and consequence analyses, facility operations/engineering, safety system/functional classification, and Technical Safety Requirements development. The identification of potential preventive and mitigative features for each hazard begins during Hazard Identification.

A comprehensive inventory, which is developed prior to conducting the PHA, produces a listing of all known radiological and chemical hazards. This information is a key input to the process of Hazard Identification. Additional hazards may be identified as a result of chemical interactions. For those facilities containing chemicals as part of their inventory, a chemical mixing study is completed as part of Hazard Identification.

Hazard Identification is divided into three steps; 1) division of the facility into "sections," 2) facility walkdowns, and 3) identification of common hazards and common hazardous events.

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Division of the Facility

Partitioning of the facility into "sections" facilitates hazard identification and evaluation. These sections may be individual unit operations, individual or grouped facility systems, specific function(s), and/or physical boundaries inside the facility.

Facility Walkdowns

Facility walkdowns include both physical walkdowns and information (or paper) walkdowns. Physical walkdowns provide first-hand observation of actual facility systems, processes, practices, equipment, and inventory. Information or paper walkdowns consist of a review of existing safety documentation, design/system drawings, procedures, functional performance requirements, etc. in the context of Hazard Identification. Physical and/or information walkdowns should be done to identify hazardous materials and energy sources for each facility section. Tables A-1 and A-2 provide a list of generic facility hazards and are useful in conducting hazard identification. This list is based on the DOE Management Oversight Risk Tree (MORT) methodology (Ref. 4).

The paper walkdown includes a review of the facility description documents, inventory, existing safety documentation such as SARs, BIOS, OSRs, Technical Standards, Project Design Documents, or Fire Hazards Analyses, and/or consultations with facility, system, and/or process experts.

When performing physical or paper walkdowns, a matrix or table containing the information from Table A-2 is typically used as an aid in documenting the results of the Hazard Identification process. Hazard Identification Tables are developed for each facility section. In some cases, e.g., a facility has only a few sections with no sub-sections or unit operations identified, a single table may be adequate to capture all the hazards.

Screening of Common Hazards

The third step in the Hazard Identification process is the identification of common hazards. "Common hazards" are defined as hazards that are routinely encountered in general industry and construction, and for which national consensus codes and/or standards (e.g., OSHA and transportation safety) exist to guide safe design and operation. In accordance with DOE-STD-3009-94 (Ref. 3), industrial hazards and routinely accepted hazards are not typically evaluated. Standard industrial hazards and routinely accepted hazards are evaluated only to the extent that they could act as initiators and contributors to events that result in radiological and/or chemical release events. The following characteristics are used to determine the hazards that are considered standard industrial and routinely accepted:

- The hazard is controlled by OSHA regulations or national consensus standards (e.g., ASME, ANSI, NFPA, IEEE, NEC), where these standards are adequate to define special safety requirements, unless in quantities or situations that initiate events with serious impact to the public, workers, or environment.

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- Hazards such as noise, electricity, flammable materials, welding operations, small quantities of chemicals that would likely be found in homes or general retail outlets, and hazardous materials transported on the open road in DOT specification containers are considered to be common hazards encountered in everyday life.

Examples of common hazards include those involving:

- specific materials (e.g., lead and asbestos) that have their own control program,
- thermal energy sources (potential for burns),
- electrical shock hazards
- gas cylinders transported and stored in DOT configuration and within design limits,
- personnel pinches, trips, falls, slips, etc.,
- confined space hazards,
- hazards typically found in office areas.

Protection against industrial hazards and routinely accepted hazards is provided by practicing basic safety in the workplace. Such hazards are formally and systematically treated by the following programmatic elements:

- Safety Standards at the Pantex Plant define basic site-wide safety policies and minimum requirements. These Standards contain rules and procedures developed by departments and facilities for activities within their areas of responsibility and requires compliance with DOE Orders and OSHA regulations, at a minimum, for industrial safety.
- The operating philosophy at the Pantex Site is that the safety and health of employees is the first and utmost priority. Policies are implemented at the facility level through facility-specific procedures.

The PHA team examines each identified hazard for each section based on material/energy types and quantities using the general guidance given above and considers its potential contribution as an initiator for events involving release of radiological material, hazardous energy, or hazardous chemicals. If the identified hazard does not meet the appropriate screening criteria for identification as a common hazard, then the hazard is not considered common and is carried forward to the Hazard Evaluation step.

2.1.2 Hazard Evaluation

The Hazard Evaluation constitutes the primary focal point of the PHA. Hazards are characterized in the context of actual or anticipated facility operations and processes by considering feasible events which could result in a release of hazardous material or energy, estimating initiating event frequency, estimating consequences of the release, and identifying

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preventors and mitigators. The purpose of the Hazard Evaluation is to ensure a comprehensive assessment of facility hazards and focus attention on those events that pose the greatest risk to the public, onsite workers, and the environment.

The Hazard Evaluation is performed to meet the requirements of DOE-STD-3009-94 (Ref. 3); and to comply with Pantex Specific Application Guide for DOE Standard 3009-94, AAO-G-3009, (Ref. 5), and the WSRC Hazard Analysis Methodology Manual (Ref. 6).

The scope of Hazard Evaluation includes:

- All aspects of facility process and operation.
- Natural phenomena (e.g. earthquakes, tornadoes, straight-line winds), external events (e.g. aircraft and vehicular impact), and nuclear criticality (where applicable).
- Consideration of the entire spectrum of possible events for a given hazard in terms of both frequency and consequence levels.
- Hazards addressed by other programs and regulations (e.g. PSM, OSHA, RCRA, DOT, EPA) if loss of control of the hazard will result in a hazardous material release.

The scope of Hazard Evaluation does not include:

- Willful acts, such as sabotage.
- Hazardous events that meet the screening criteria given in Section 2.1.1.

Detailed information regarding hazardous material and energy sources in the context of facility section and/or whole facility operations are the bases for specific release events. Event categorization, identification of event cause(s), assignment of initiating event frequency and unmitigated consequence level, identification of common or standard industrial hazardous events, initial risk binning, identification of mitigative and preventive features, and final consequence determination are tasks performed during Hazard Evaluation.

Information related to Hazard Evaluation is collected and organized in "Hazard Evaluation Tables." (Tables A-7 and A-8 of Appendix A). These tables are a useful guide for performing Hazard Evaluation, and they provide an effective format for documenting Hazard Evaluation results. A separate Hazard Evaluation Table is constructed for each facility section. Information in these tables includes:

- Event Number
- Event Category
- Postulated Event Description (includes location and hazard source)
- Causes
- Initiating Event Frequency Level
- Unmitigated Consequences to On-Site Worker, Facility, and Off-Site individual; and impact on other systems

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- Risk Bin Number
- Preventive Features/Resulting frequency estimate
- Mitigative Features
- Mitigated Consequences

Additional detail and pertinent methodology information regarding each of the Hazard Evaluation Table categories is provided in the following sections.

2.1.2.1 Event Number

Events are numbered to provide each with a sequential reference. The numbering system is chosen such that facility section is identified mnemonically. For example, a facility section identified as "Pump House" might be abbreviated as "PH" in the Hazard Evaluation table. Events associated with the pump house would then be numbered PH-1, PH-2, etc.

2.1.2.2 Event Category

Events are categorized according to the nature of the postulated event description. A standard list of event categories, based on those given in Appendix E of DOE/TIC-11603 (Ref. 7), is used. They are as follows:

- E-1 Fire
- E-2 Explosion
- E-3 Loss of Containment/Confinement
- E-4 Direct Radiological/Chemical Exposure
- E-5 Nuclear Criticality
- E-6 External Hazards
- E-7 Natural Phenomena

Events are generally categorized according to the event description rather than the event cause. For example, a facility fire might be a postulated event that is caused by an earthquake or some other natural phenomena. This event would fall under category E-1 (Fire) rather than E-7 (Natural Phenomena). Table A-1 gives additional information regarding event categories and associated hazardous material and energy sources.

2.1.2.3 Postulated Event Description

A brief description of a postulated event is given in this column of the Hazard Evaluation Tables. The event description clearly defines the nature of the event. It includes the type of event, its location, hazard source, affected system(s) or equipment, and any pertinent operating characteristics.

Using the Hazard Identification Tables as a basis, the PHA team develops event scenarios for each facility section wherever a potential exists for a release of hazardous energy and/or material. The scenarios cover the entire spectrum of possible events for a given hazard; from small consequence events to reasonable worst-case conditions. Unlike "worst-case,"

"reasonable worst-case" does not necessarily consider every parameter in its most unfavorable

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state. For example, if a toxic material is normally handled as a liquid at room temperature during processing, a reasonable worst-case release does not have to consider a spill with the liquid at 130°F.

2.1.2.4 Causes

A cause specifically states the failure, error, operational, and/or environmental condition that could initiate the postulated event. Causes need to be clearly identified to support frequency evaluation. The Hazard Identification Tables are used as a guide in developing specific causes for release events.

2.1.2.5 Initiating Event Frequency Level

Event frequency evaluation is a qualitative or quantitative process that involves assigning a frequency level to each event in the Hazard Evaluation Tables. Frequency levels and descriptions are summarized in the Frequency Evaluation Levels (Table A-3) which are based on DOE-STD-3009-94 (Ref. 3).

The frequency level determination is based on the event's root cause(s). Sources of frequency information could include: generic initiator data base, engineering calculations, analyses for other facilities, and expert opinion. The frequency level is recorded in the Hazard Evaluation Tables according to the lettering scheme given in Table A-3.

Uncertainties in frequency levels are accommodated by erring in the conservative direction from best-estimate values. This practice is particularly important when an event frequency is just below the next highest frequency level. For example, the PHA team, considering the sources, methods, and uncertainty associated with frequency determination, might collectively decide to call an event "Anticipated" if the event has been estimated to have an initiator frequency at the high end of the "Unlikely" level.

2.1.2.6 Unmitigated Consequences

Event consequences are documented by specifying the impact on the receptors (described below). Any potential impact of consequences on other systems is also documented in the Hazard Evaluation Tables.

For PHA purposes, consequences are defined as 1) the dose or exposure at specified receptor locations based upon unmitigated release of hazardous material and 2) the impact to the worker or facility. Consequences are a function of the type and characteristics of the hazard, the quantity released, the release mechanism, relative location of the release, and any relevant transport characteristics. Consequences are determined from: (1) simple source term calculations, (2) existing safety documentation, and/or (3) qualitative assessment. The PHA team utilizes its discretion, expertise, and knowledge of facility hazards to select one or more of the above methods appropriate for consequence determination. Unlike frequency levels, that cover two orders of magnitude, consequence levels sometimes span less than one order of magnitude. Thus, a more refined effort may be required to determine the appropriate consequence level for a given event and receptor. As in frequency evaluation, the consequence should err in the

conservative direction, especially for those events with consequences at the high end of a given level.

Consequences are evaluated at various receptor locations and for the facility to assess health and environmental effects associated with the postulated event. Table A-4 gives the consequence levels for radiological releases and their relationship to specified receptor locations. Receptors are Offsite and Onsite. Offsite receptors are the public, or everyone outside the site boundary. Onsite workers are considered to be those inside the Plant boundary including those in and near the facility. The Hazards Analysis is concerned with the maximally exposed individual at each receptor location.

The PHA team also performs a qualitative assessment of the impact non-release events have on the facility being evaluated. Table A-4 gives the consequence levels for these events.

The Hazard Evaluation Tables should provide, for each of the postulated release events, the impact of the event on the receptors and facility. This information is documented in the column labeled "Health and Safety Consequence Level" under the "Unmitigated" heading of the Hazard Evaluation Tables. Common or standard industrial hazards are noted accordingly and are excluded from further consideration.

For completeness, any potential impacts on other systems are also considered and are listed in the Hazard Evaluation Tables in the "Impact on Other Systems" columns under the "Unmitigated" heading.

2.1.2.7 Risk Ranking

Using event frequency and consequence levels, the PHA team "bins" events in frequency-consequence space to assess relative risk in accordance with AAO-G-3009 (Ref. 5) and the WSRC Hazards Analysis Methodology Manual (Ref. 6). The objective of risk binning is to focus attention on those events that pose the greatest risk to the public, onsite receptors, facility, and the environment. In accordance with AAO-G-3009 (Ref. 5), higher risk events are candidates for additional analysis and/or safety classification evaluation.

Tables A-5 and A-6 are risk binning matrices for the receptor locations considered in the PHA (i.e., onsite/facility and offsite). In each of these tables, bins are defined by a rectangular matrix in frequency-consequence space. Each bin is numbered, but numbering is for identification purposes only. Risk severity is not proportional to the magnitude of the bin label.

Table A-5 is the risk binning matrix for the Onsite receptor and Facility. The unshaded bins, (i.e., 1, 4, and 7), represent risk that exceeds the evaluation guidelines for onsite workers (Table A-4). Events falling into these bins require SSCs which will perform a Safety Significant function to protect the onsite worker. The lightly shaded bins (bins 2 and 5) represent "situations of concern". Events falling into these bins are those for which controls (e.g., SSCs, administrative controls) do not warrant the level of coverage needed in Technical Safety Requirements but are "important to safety" such that operations should not be conducted unless these controls are operable. The darker shaded bins in Table A-5 represent those events which require no further safety controls or analyses.

Table A-6 is the risk binning matrix for Offsite receptors, i.e., anyone who is located beyond the site boundary. The unshaded bins, (i.e., 1, 2, 3, 4, 5, 7 and 10), represent risk that exceeds the evaluation guidelines for offsite receptors (Table A-4). Events falling into these bins and have a consequence greater than 25 rem require SSCs which will perform a Safety Class function to protect the offsite individuals and evaluation as design basis accidents. All other events falling in the unshaded bins require safety significant SSCs. The shaded bins in Table A-6 represent those events which require no further analysis or safety controls.

The Hazard Evaluation Tables provide, for each of the postulated release events, a bin number representing risk at each receptor location.

2.1.2.8 Preventive Features

A preventive feature is any feature that is relied on to act to reduce the frequency of an initiating cause that could result in the release of hazardous material or energy to an unwanted location. Preventive features might include engineered features (e.g. structures, systems, components, etc.) and administrative controls (e.g. procedures, policies, programs, etc.), operating individually or in combination. The Hazard Evaluation Tables are formatted such that a distinction is made between administrative and engineered (design) features. Preventive features are those which are assumed to be operable prior to an event and are not required to be operable during the event or post event.

2.1.2.9 Mitigative Features

Mitigative features are any features that are relied on to reduce the consequences associated with the release of hazardous material or energy. Mitigative features are those which are assumed to be operable during an event or after the event, and are not required to be operating prior to the event initiation. Therefore, mitigative features must be capable of withstanding the environment of the event. As with preventive features, mitigative features might include engineered features or administrative controls operating individually or in combination. The Hazard Evaluation Tables make the distinction between administrative and engineered (design) features.

2.1.2.10 Mitigated Consequences

Having identified the preventers and mitigators which act to reduce the frequency or consequences of hazardous events, the next step is to estimate and record the resulting frequency and consequences for each event after taking credit for these controls. This step includes verification that the controls would move the risk associated with those events from the unshaded portion of Tables A-5 and A-6 to the shaded areas.

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2.2 HAZARD ANALYSIS RESULTS

As discussed in Section 2.1, the PHA consists of two basic analytical activities: hazard identification and hazard evaluation. This section provides an in-depth discussion of the results from the performance of these activities for the SPSF.

The SPSF PHA team included, on an as-required basis, representatives from the following disciplines:

- Hazard Analysis
- Risk Management/Analysis
- Projects Engineering
- Facilities Operations/Engineering
- Fire Protection
- Criticality Analysis
- Packaging and Shipping

2.2.1 Hazard Identification

In accordance with the methodology given in Section 2.1.1, hazards associated with the SPSF were systematically identified by listing hazardous materials, energy sources, and their locations in tables to ensure completeness. Screening was performed to eliminate material/energy types and quantities that are considered "common hazards." Hazard Identification was divided into three steps; 1) division of the facility into "sections," 2) facility/information walkdowns, and 3) identification of common hazards.

Division of the Building 12-66 Surplus Pit Storage Facility

The Surplus Pit Storage Facility was divided into five sections to facilitate hazard identification and evaluation. These sections were based upon the physical locations of the various rooms or areas, their contents and functions, and flow of material in the building. The sections are (with acronym used in the Hazard Evaluation Table):

- Pit Storage Room (PS)
- Loading Dock/Ramp (LD)
- Control Room (CR)
- Interlock (IN)
- Equipment Room (ER)

Facility Walkdowns

A physical walkdown of Building 12-66 was performed with personnel from Manufacturing and Facilities Divisions. In addition, a number of documents associated with the current and proposed functions of Building 12-66 were reviewed with Project Management and facility personnel. These included:

- Preliminary Design Report for the upgrade of Building 12-66 (Ref. 1)

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- Existing Safety Analysis Report for Building 12-66 (Ref. 8)
- Operating Procedures for the Stage Right process (Ref. 2, 9, and 10)
- Existing Fire Hazards Analysis for Building 12-66 (Ref. 11)
- SARP for AL-R8 containers (Ref. 12)

Screening of Common Hazards

Using the guidance provided in Section 2.1.1, members of the PHA team examined each identified hazard for each section to determine its potential contribution to events resulting in release of radiological material, hazardous energy, or hazardous chemicals.

If the identified hazard did not meet the appropriate screening criteria for identification as a common hazard, the hazard was carried forward through the complete Hazard Evaluation step.

Results of Hazard Identification

Table B-1 of Appendix B, Hazard Identification Tables, lists identified hazards (those not screened as common industrial or routinely accepted according to criteria in Section 2.1.1) and corresponding locations for each section in the Surplus Pit Storage Facility. Since no chemicals were identified for use in the SPSF, no chemical mixing study was necessary as part of the Hazard Identification process.

2.2.2 Hazard Evaluation

The Hazard Evaluation results for the Surplus Pit Storage Facility are documented in Appendix C (Tables C-1 through C-5) of this report.

One of the purposes of the Hazard Evaluation at the conceptual design phase is to identify the potential events that could impact the onsite receptors, the facility, or the offsite receptors. The results from the Hazard Evaluation can be used for future safety classification of the Structure, Systems, and Components in the Surplus Pit Storage Facility.

To support the selection of the applicable risk bin for the identified events, representative scenarios were developed. Consequences were then semi-quantitatively developed for these representative scenarios. For the consequence determination, no credit was taken for any controls (i.e., it was assumed that there was no cladding, there were no containers, there was no control on combustibles, the building provided no structural barrier, etc.). In developing the scenarios, the following three parameters were varied depending on the event and the location:

- (1) Number of pits involved in the event
- (2) Material per pit that would be released during the event

(3) Dose rate per kg of material released

Each of these is discussed below.

Number of pits: The representative events were always assumed to involve the total pits available in the area: for the loading dock, the maximum number of pits is 36; for the interlock, the maximum number of pits is 6; and for the pit storage room, the maximum number of pits is 12,044. For some events, the pits were subdivided to account for different conditions impacting different pits.

Material released per pit: To determine the amount of material released per pit, the damage ratio, airborne release fraction, airborne release rate, and respirable fraction had to be evaluated based on the scenario. Based on the events identified, the first four scenarios developed assumed the release was due to thermal stress or oxidation. Release quantities were developed for 1000°C, 600°C, 200°C and 20°C (Ref. 13). Additionally, for the events that included a physical impact to the pits, a conditioning of the pits was used to develop a conservative oxidation layer prior to impact. This conditioning assumed 90°C and 95% relative humidity for a period of 30 days. The results showing material release per pit are summarized in Table D-1.

Dose per kg released: To develop the doses, centerline effective dose equivalent (EDE) values for ground release on one kilogram of Pu-239 were calculated for the onsite receptor and the maximally exposed offsite individual (Ref. 14). For the onsite receptor, values were developed for the 50th quantile without regard to sector, and for the offsite receptor values were for the 95th quantile without regard to sector. To account for the varying event conditions and times for release of the material, the dose was calculated for releases of 3 minutes, 30 minutes, and one hour. The results showing the onsite and offsite dose per kg released are summarized in Table D-2.

To determine the representative consequences, five representative event scenarios were developed:

- (1) large fire
- (2) small fire
- (3) oxidation followed by an impact
- (4) oxidation at 20 C for the storage life
- (5) aircraft impact

Events (2), (3), (4), and (5) are applicable to multiple locations, and consequences were calculated for each location. The description of each scenario and supporting calculations are provided in Appendix D. A summary of the resulting consequences to onsite workers and the offsite public is given in Table D-3.

For each postulated event in the hazard identification table that involved the release of

radiological material, the representative event that would bound the potential release of the postulated event was selected. Then the consequences of that representative event with the frequency of the postulated event were used to bin the postulated event using Tables A-5 and A-6. The representative event that was used is identified in the hazard evaluation table in the "Health and Safety Consequence Level" column. The applicable bins are identified in the "Risk Bin Number" column.

Energy Release Not Involving Hazardous Material

Hazardous events that did not result in a release of hazardous material were evaluated for impacts to the onsite worker. If the hazardous event was identified as a common industrial hazard where the identification of the required controls is covered by a code, standard, or Pantex program, reference was made to the applicable code, standard, or program in the Hazard Evaluation Table (column identified as "Health and Safety Consequence Level"). For all other events, the level of consequence to the onsite worker was determined in accordance with Table A-5. The consequence level and risk bin are identified in the Hazard Evaluation Tables.

Facility Damage

Facility damage due to NPH events is assessed in accordance with DOE-STD-1021 (Ref. 15) with the appropriate performance category assigned. Therefore, this damage is not assessed during the Hazard Evaluation. For the Hazard Evaluation process, facility damage for non-NPH events and facility damage due to contamination were evaluated. Contamination was qualitatively evaluated using the consequence values of the representative events identified for onsite and offsite receptors. Facility damage was qualitatively assessed in accordance with Table A-5. The consequence level and risk bin are identified in the Hazard Evaluation Tables. When an event could impact more than one criteria (e.g., facility damage and facility contamination), the consequence level and risk bin for the worst consequence are recorded.

Environmental Impact

Environmental impact was assessed as an environmental contamination according to the criteria provided in Table A-6. The level of contamination was qualitatively evaluated using the consequence values for the associated representative event used for offsite receptor exposure. Only in cases where the exposure was less than the threshold for "low", and it was determined that more than negligible contamination would occur, was the consequence level due to contamination used. For all other cases, the exposure to the offsite individual governed the consequence level and risk bin determination.

Criticality

The isotope of concern in the SPSF is Pu-239. Because of the amount of Pu-239 involved, criticality is assumed to be a credible event. With regard to storage capability, it is assumed that the building is designed such that it could contain all 12,044 of the pit containers and still remain sufficiently sub-critical. The mechanism by which a criticality might occur is postulated to involve failure of the storage system such that the containers are reconfigured with an unfavorable geometry. This could be the result of an AGV collision (causing several pallets to

fall to the floor), pallet failure due to corrosion, or an earthquake. Of the sections identified, the concern for a criticality applies only to the Pit Storage Room. A detailed analysis is being performed to provide more definitive information regarding criticality potential.

Hazardous Chemical Release Consequence

No chemicals have been identified for use in the SPSF operations (Ref. 1).

Hazard Evaluation Results

The hazard evaluation process identified a total of 73 potential hazardous event scenarios. Of these, 7 scenarios were determined to be common hazardous events that have controls determined by other parts of the Pantex Integrated Safety Management program and did not require further evaluation or additional controls.

For the offsite receptor, there were 11 scenarios that require the identification of preliminary Safety Class controls (i.e., those that are in risk bins 1, 4, or 7 of Table A-6 and have a consequence greater than 25 Rem. These are indicated by an asterisk in the Hazard Evaluation Tables). In addition, there were 12 scenarios that require Safety Significant Controls (i.e., those that are in risk bins 1, 2, 3, 4, or 5 of Table A-6 and have consequences less than 25 rem). No further analyses or controls to protect the offsite public are required for 17 events (those that are in risk bins 6, 8, 9, 11, 12, and 13 of Table A-6). For 26 events, the consequences were not applicable to the offsite public.

For the onsite worker, there were 29 scenarios that require the identification of Safety Significant controls (i.e., those that are in risk bins 1, 4, or 7 of Table A-5). There were 10 scenarios that require Important to Safety controls (i.e., those that are in risk bins 2 or 5 of Table A-5). No further analyses or controls to protect the onsite worker are required for 21 events (those that are in risk bins 3, 6, 8, 9, 10, 11, and 12 of Table A-5). For 6 events, determination of consequences was not required (i.e., the event was considered but was deemed impossible, e.g., a criticality in the Interlock, event IN-7; or, the consequences of the event were covered by another event, e.g., event ER-5).

For the Facility, there were there were 12 scenarios that require the identification of Safety Significant controls (i.e., those that are in risk bins 1, 4, or 7 of Table A-5). There were 20 scenarios that require Important to Safety controls (i.e., those that are in risk bins 2 or 5 of Table A-5). No further analyses or controls are required for 28 events (those that are in risk bins 3, 6, 8, 9, 10, 11, and 12 of Table A-5). Determination of consequences was not required for 6 events.

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3. CONCLUSIONS

A comprehensive review of hazards associated with the Building 12-66 Surplus Pit Storage Facility was performed to identify postulated hazardous event scenarios. To determine the unmitigated risk of these events, a Preliminary Hazards Analysis was performed; the results are summarized in Appendices B, C, and D. The offsite dose to the maximally exposed individual at the site boundary from some unmitigated events exceeds the Evaluation Guidelines. Based on the analyses presented in this report, structures, systems or components (SSCs) will be required to perform a Safety Class function to mitigate or reduce the frequency of these events.

In addition, there are events with consequences below 25 rem but exceed the offsite acceptance criteria defined in AAO-G-3009 (Ref. 5), and there are events that exceed the onsite acceptance criteria for worker safety and facility damage. Based on the analyses presented in this report, structures, systems or components (SSCs) will be required to perform a Safety Significant or Important to Safety function to mitigate or reduce the frequency of these events.

Future actions in the development of the Hazards Analysis for the SPSF will include the identification of the controls and the determination of the consequences with the controls. The result of these actions will be incorporated into later revisions of this document.

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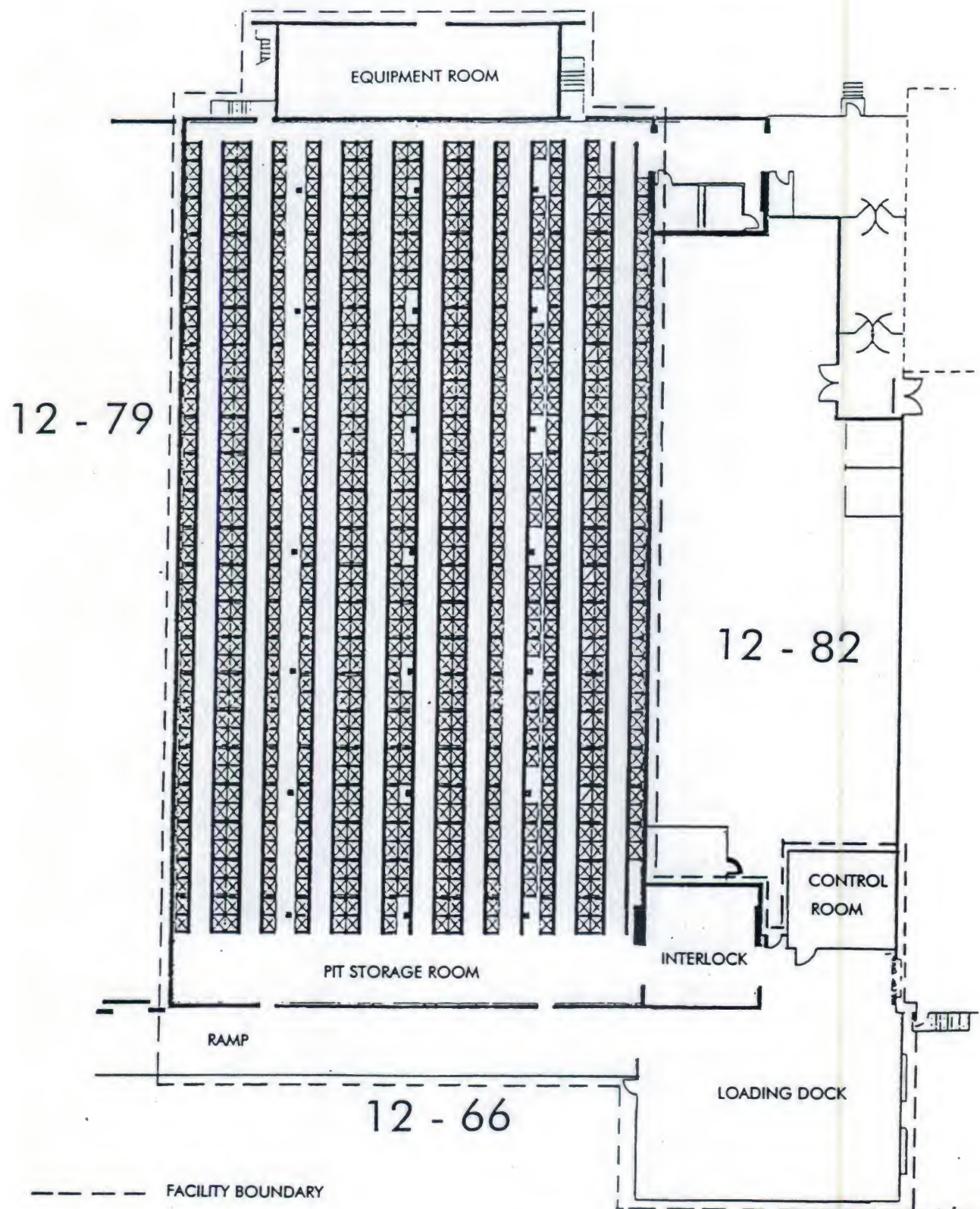
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Figure 1 - Surplus Pit Storage Facility Layout



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APPENDIX A - METHODOLOGY TABLES

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Table A-1. Event Categories & Relationship to Hazardous Material and Energy Sources

Event Category	Event Category Description	Hazard Energy and Material Groups
E-1	Fire	Electrical Thermal Friction Pyrophoric material Spontaneous combustion Open flame Flammables Combustibles Chemical Reactions
E-2	Explosion	Potential (pressure) Explosive materials Chemical Reactions
E-3	Loss of Containment or Confinement	Radiological Material Hazardous Material
E-4	Direct Radiological/Chemical Exposure	Ionizing radiation sources Non-ionizing radiation sources
E-5	Nuclear Criticality	Fissile Material
E-6	External Hazards	Non-facility Events Vehicles in Motion Crane Kinetic
E-7	Natural Phenomena	Natural Phenomena

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Table A-2 Hazard Energy Source Legend

Group	Hazard Energy Source	Abbreviation
Electrical	Battery banks	BB
	Cable runs	CB
	Diesel units	DU
	Electrical equipment	EE
	Hot plates	HP
	Heaters	HT
	High voltage	HV
	Locomotive, Electrical	LE
	Motors	MT
	Pumps	PM
	Power tools	PT
	Switchgear	SG
	Service outlets, fittings	SO
	Transformers	TF
	Transmission lines	TL
Underground wiring	UW	
	Wiring	WR
Thermal	Bunsen burner/ Hot plates	BR
	Electrical equipment	EE
	Furnaces	FR
	Heaters	HT
	Steam lines	SL
	Welding torch	WT
Friction	Belts	BL
	Bearings	BR
	Fans	FN
	Gears	GE
	Motors	MT
	Power tools	PT
Pyrophoric Material	Pu and U metal	PU
Spontaneous Combustion	Nitric acid and organics	HN
Open Flame	Bunsen burners	BR
Flammables	Flammable gases	FG
	Flammable liquids	FL
Combustibles	Combustible materials	CB
Chemical Reactions	Uncontrolled chemical reactions	CH
Potential (pressure)	Gas bottles	GB
	Gas receivers	GR
	Pressure vessels	PV
	Steam headers and lines	ST

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Table A-2 (cont.) - Hazard Energy Source Legend

Group	Hazard Energy Source	Abbreviation
Explosive Material	Explosive gases	EG
	Explosive chemicals	EC
	Hydrogen	HZ
	Propane	PP
Radiological Material	Radiological Material	RM
Hazardous Material	Alkali Metals	AM
	Asphyxiants	AS
	Biologicals	BI
	Carcinogens	CA
	Corrosives	CR
	Oxidizers	OX
	Toxics	TX
Ionizing Radiation Sources	Fissile material	FM
	Radiography equipment	RE
	Radioactive material	RM
	Radioactive sources	RS
Fissile Material	Fissile Material	FM
Non-facility Events	Explosion	EX
	Fire	FI
	Other	OT
Vehicles in Motion	Airplane	AP
	Helicopter	HL
	Forklift	FL
	Truck/Car	TR
Crane	Crane	CR
Natural Phenomena	Straight wind	SW
	Tornado	TO
	Earthquake	EQ
	Flood	FD
	Lightning	LT
	Rain	RN
Snow, freezing weather	SN	

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Table A-3 Event Frequency Evaluation Levels

Event Frequency Code	Description	Estimated Annual Frequency of Occurrence (year ⁻¹)
Anticipated (A)	Accidents that may occur several times during the life cycle of the facility (accidents that commonly occur).	$f > 10^{-2}$
Unlikely (U)	Accidents that are not anticipated to occur during the life cycle of the facility. Natural phenomena of this probability class include the following: Uniform Building Code-level earthquake, 100-year flood, maximum wind gust, etc.	$10^{-2} \geq f > 10^{-4}$
Extremely Unlikely (EU)	Accidents that will probably not occur during the life cycle of the facility. This class includes the design basis accidents.	$10^{-4} \geq f \geq 10^{-6}$
Beyond Extremely Unlikely (BEU)	All other accidents.	$f < 10^{-6}$

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Table A-4 Evaluation Guidelines

Consequence Level ↓	Criteria for Worker	Criteria for Facility	Criteria for Off-Site
High (H)	<u>Radiological</u> : > 100 rem; <u>Any Event</u> : Loss of Life or Severe Injury	Complete Loss of Facility	>25 rem CEDE at Extr. Unlikely >5rem CEDE at Unlikely > 0.5 CEDE at Anticipated Major Off-Site Contamination
Moderate (M)	<u>Radiological</u> : $25 < C \leq 100$ rem; <u>Any Event</u> : Lost Time Accident but no Disability	Major Contamination or Damage	>12.5 rem CEDE at Extr. Unlikely >2.5 rem CEDE at Unlikely >0.25 rem CEDE at Anticipated Moderate Off-Site Contamination
Low (L)	<u>Radiological</u> : $5 < C \leq 25$ rem <u>Any Event</u> : Minor First Aid	Minor Contamination or Damage	>6.2 rem CEDE at Extr. Unlikely >1.2 rem CEDE at Unlikely >0.12 rem CEDE at Anticipated Low Off-Site Contamination
Negligible (N)	<u>Radiological</u> : ≤ 5 rem <u>Any Event</u> : No Impact	No Damage	No Off-Site Contamination or Exposure

Table A-5 Risk Ranking Matrix - MEOW and Facility

Frequency → Consequence ↓	Beyond Extremely Unlikely $< 10^{-6}$ /yr	Extremely Unlikely $10^{-6} \leq f \leq 10^{-4}$ /yr	Unlikely $10^{-4} < f \leq 10^{-2}$ /yr	Anticipated $> 10^{-2}$ /yr
High <u>Worker Radiological:</u> > 100 rem; <u>Any Event:</u> Loss of Life or Severe Injury <u>Facility:</u> Complete Loss of Facility		7	4	1
Moderate <u>Worker Radiological:</u> $25 < C \leq 100$ rem; <u>Any Event:</u> Lost Time Accident but no Disability <u>Facility:</u> Major Contamination or Damage			5	2
Low <u>Worker Radiological:</u> $5 < C \leq 25$ rem <u>Any Event:</u> Minor First Aid <u>Facility:</u> Minor Contamination or Damage				
Negligible (Any Hazard $< \text{low}$) <u>Worker Radiological:</u> ≤ 5 rem <u>Any Event:</u> No Impact <u>Facility:</u> No Damage				

Key:

No Analysis	
Determine Safety Significant	
Determine Important to Safety	

Table A-6 Risk Ranking Matrix - MEOI

Frequency → Consequence ↓	Beyond Extremely Unlikely $< 10^{-6}$ /yr	Extremely Unlikely $10^{-7} \leq f \leq 10^{-4}$ /yr	Unlikely $10^{-4} < f \leq 10^{-2}$ /yr	Anticipated $> 10^{-2}$ /yr
High Major Off-Site Contamination	10	7 >25 Rem	4 >5 Rem	1 >0.5 Rem
Moderate Moderate Off-Site Contamination			5 >2.5 Rem	2 >0.25 Rem
Low Low Off-Site Contamination			3 >0.12 Rem	
Negligible No Off-Site Exposure or Contamination				

Key:

No Analysis	
Analysis	

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Table A-7 Hazard Evaluation Table, Unmitigated Consequences (Example)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
PH-1	E-1	"Description"			Worker: Facility: Offsite:		
		Location:					
		Hazard Source:					
PH-2	E-3	"Description"			Worker: Facility: Offsite:		
		Location:					
		Hazard Source:					

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Table A-8 Hazard Evaluation Table, Mitigated Consequences (Example)

Event No.	Event Category	Postulated Event Description	Causes	Prevention Features		Freq. Level	Mitigation Features		Mitigated	
				Design	Administrative		Design	Administrative	Impact on Other Systems	Health and Safety Consequence Level
PH-1A	E-1	"Description"								
		Location:								
		Hazard Source:								
PH-2A	E-3	"Description"								
		Location:								
		Hazard Source:								

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APPENDIX B - HAZARD IDENTIFICATION TABLES

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TABLE B-1 Summary of Hazard Energy Sources, Materials, and Their Locations for the Surplus Pit Storage Facility (page 1 of 4)

Location	Hazard Energy Sources and Materials																						
	Electrical										Thermal												
	BB	CB	DU	EE	HP	HT	HV	LE	MT	PM	PT	SG	SO	TF	TL	UW	WR	BR	EE	FR	HT	SL	WT
Pit Storage Room	X		X	X ⁴				X ¹⁰				X				X ¹⁵			X				
Loading Dock/Ramp ¹	X ²	X	X	X ³	X ⁸			X ¹¹		X ¹⁴	X	X				X			X		X		
Control Room		X	X	X ⁶								X				X			X				
Interlock	X	X	X	X ⁷	X ⁹			X ¹²				X				X			X		X		
Equipment Room	X ³	X	X	X	X ⁸			X	X ¹³		X	X	X			X			X		X ⁸	X	

X = Hazards considered applicable

a e.g., breakers

1 Pallet Turner to be located on the Loading Dock

2 Battery charger; batteries on forklift

3 Batteries for fire detection system

4 CCTV Cameras

5 Pallet turner

6 Computer equipment

7 Security equipment

8 Electric unit heaters; radiator heaters w/fans (Loading Dock)

9 Electric heater with fan

10 Drive motors for doors; portable CAM units

11 Dock levelers

12 Door motors; motor on heater fan

13 Pumps for condensate return, chilled water, sump transfers

14 Potential for use of power tools such as impact wrench (e.g.,

for re-palletizing containers)

15 Temperature monitoring, PA system

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TABLE B-1 (cont.) Summary of Hazard Energy Sources, Materials, and Their Locations for the Surplus Pit Storage Facility (page 2 of 4)

Location	Hazard Energy Sources and Materials											Chemical Reactions ^c		
	Friction			Pyrophoric Materials ^a	Spontaneous Combustion ^b	Open Flames	Flammables		Combustibles					
	BL	BR	FN				GE	MT					PT	FG
Pit Storage Room				X	X		PU	HN	BR		FG	FL	CB	CH
Loading Dock/Ramp ¹	X		X	X	X	X	2				X ³	X ⁴	X	
Control Room													X	
Interlock			X	X	X		2				X ³	X ⁴		
Equipment Room	X	X	X		X	X					X ³	X ⁶	X	

X = Hazards considered applicable

a Plutonium or Uranium metal

b e.g., nitric acid and organics

c With potential for uncontrolled reaction

1 Pallet Turner to be located on the Loading Dock

2 No material will be exposed or outside storage containers. material is assumed to undergo oxidation before ignition would occur.

3 Hydrogen generated by batteries

4 Hydraulic fluid; door gear lubricant

5 Includes paints, solvents, adhesives, oils, and various other chemicals and flammable liquids delivered to dock for support of other facilities. This material is not part of the Surplus Pit

Storage Facility's inventory. The material is transient only and is considered only as an initiator for events which could impact the Storage Facility or its radiological inventory.

6 Bearing lubricant; oil reservoir on air compressor

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TABLE B-1 (cont.) Summary of Hazard Energy Sources, Materials, and Their Locations for the Surplus Pit Storage Facility (page 3 of 4)

Location	Hazard Energy Sources and Materials																				
	Potential (Pressure)				Explosives				Radiological Material				Hazardous Material					Ionizing Radiation			
	GB	GR	PV	ST	EG	EC	HZ	PP	RM	AM	AS	BI	CA	CR	OX	TX	FM	RE	RM	RS	
Pit Storage Room							X		X							X ¹	X		X		
Loading Dock/Ramp ¹					X ²	X		X		X ²		X ²	X ²	X ²	X ^{2,3}	X	X		X		
Control Room																					
Interlock							X	X								X ³	X		X		
Equipment Room	X						X														

X = Hazards considered applicable
 1 Pallet Turner to be located on the Loading Dock
 2 Includes paints, solvents, adhesives, oils, and various other chemicals and flammable liquids delivered to dock for support of other facilities. This material is not part of the Surplus Pit Storage Facility's inventory. The material is transient only and is considered only as an initiator for events which could impact the Storage Facility or its radiological inventory.
 3 Radiological material inside storage containers.

TABLE B-1 (cont.) Summary of Hazard Energy Sources, Materials, and Their Locations for the Surplus Pit Storage Facility (page 4 of 4)

Location	Hazard Energy Sources and Materials																
	Fissile Material ^a			Non-Facility Event ^b			Vehicles in Motion				Crane ^c		Natural Phenomena ^d				
	FM	EX	FI	OT	AP	HL	FL	TR	CR	SW	TO	EQ	FD ⁵	LT	RN	SN	
Pit Storage Room	X	X	X		X	X	X			X	X	X		X	X	X	
Loading Dock/Ramp ¹	X	X	X		X	X	X ⁴			X	X	X		X	X	X	
Control Room		X	X		X	X	X ³			X	X	X		X	X	X	
Interlock	X	X	X		X	X	X			X	X	X		X	X	X	
Equipment Room		X	X	X ²	X	X				X	X	X		X	X	X	

X = Hazards considered applicable
a Criticality concern
b External to Facility
c Internal to Facility
d Indicates NPH incident upon Building. Accident scenarios associated with NPH are listed in Hazard Evaluation Table
1 Pallet Turner to be located on the Loading Dock
2 Potential for crane to service second floor of Equipment Room
3 Frequent movement of forklift on Loading Dock immediately adjacent to the Control Room
4 Delivery trucks external to loading dock
5 Not a viable phenomenon because of Plant location

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APPENDIX C - HAZARD EVALUATION TABLES

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Table C-1 Hazard Evaluation Table for SPSF Pit Storage Room, Unmitigated Consequences (page 1 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated				Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level		
PS-1	E-1	Radiological material release from pit containers due to fire in pit storage room Location: Pit Storage Room Hazard Sources: Radioactive Material	Hydraulic fluid on AGV or forklift; ignition source on AGV; electrical short; unknown ignition source.	A	Shutdown of the affected area.	Worker: MODERATE	The consequences of this event are bounded and represented by the consequences calculated for a small fire event.	2
				1		Facility: MODERATE		2
						Offsite: HIGH		1
PS-2	E-1	Pyrophoric material Location: Pit Storage Room Hazard Source: Radioactive Material	NA	NA		Worker: NA		NA
						Facility: NA		NA
						Offsite: NA		NA
PS-3	E-2	Radiological release from pit container due to an explosion Location: Pit Storage Room Hazard Source: Radioactive Material	Hydrogen generated by batteries in AGV, shielded forklift; ignition source on AGV; electrical short; unknown ignition source.	A	Shutdown of the affected area; potential for release of radiological material to the environment.	Worker: MODERATE	The consequences of this event are bounded and represented by the consequences calculated for a small fire event.	2
				1		Facility: MODERATE		2
						Offsite: HIGH		1

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Table C-1 Hazard Evaluation Table for SPSF Pit Storage Room, Unmitigated Consequences (page 2 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
PS-4	E-3	Radiological release from pit container due to damage resulting from mishandling of pit container Location: Pit Storage Room Hazard Source: Radioactive Material	Worker error; failure of computer control for AGV; containers are dropped, pushed over, pierced, or otherwise damaged with forklift tine.	A	Temporary shutdown of the affected area and the pit storage operation; potential for release of radiological material to the environment; contamination of equipment in pit storage room.	Worker: HIGH Facility: MODERATE Offsite: HIGH	1 2 1*
						The consequences of this event are bounded and represented by the consequences calculated for an impact event.	* Requires Safety Class
PS-5	E-3	Radiological release from pit container due to damage caused by object falling from ceiling Location: Pit Storage Room Hazard Source: Radioactive Material	Aging or corroding structures in ceiling (e.g., light fixtures, sprinkler piping, pipe hangers).	U	Potential for temporary shutdown of affected area and the pit storage operation; potential for contamination to be spread to other areas including the environment.	Worker: HIGH Facility: MODERATE Offsite: HIGH	4 5 4*
						The consequences of this event are bounded and represented by the consequences calculated for an impact event.	* Requires Safety Class
PS-6	E-3	Radiological release due to leaking container. Location: Pit Storage Room Hazard Source: Radioactive Material	Age of containers and pits; corrosion of pit shell; loss of cooling to storage room (HVAC failure); container overheating results in pit cracking.	A	Temporary shutdown of affected area; potential for transferable contamination to be spread to other areas.	Worker: HIGH Facility: MODERATE Offsite: HIGH	1 2 1
						The consequences of this event are bounded and represented by the consequences calculated for an oxidation event.	

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Table C-1 Hazard Evaluation Table for SPSF Pit Storage Room, Unmitigated Consequences (page 3 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Initiator Freq. Level	Unmitigated			Risk Bin Number
					Impact on Other Systems	Health and Safety Consequence Level		
PS-7	E-5	Criticality Location: Pit Storage Room Hazard Source: Radioactive Material	Earthquake, AGV collision, pallet failure causes pallets to collapse or tip over resulting in unfavorable configuration of containers in floor; worker error.	U	Major disruption of SPSF functions; major effort required for recovery; potential for high radiation exposure doses to workers in adjacent buildings (12-79 and 12-82)	Worker: HIGH Facility: MODERATE Offsite: HIGH	4 5 4*	* Requires Safety Class
				A	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of pit storage room and associated equipment..	Worker: MODERATE Facility: MODERATE Offsite: HIGH The consequences of this event are bounded and represented by the consequences calculated for a small fire event.	2 2 1	
				U	Temporary shutdown of the storage operation; potential for release of radiological material to the environment; contamination of pit storage room.	Worker: HIGH Facility: MODERATE Offsite: HIGH The consequences of this event are bounded and represented by the consequences calculated for an impact event.	4 5 4*	* Requires Safety Class
PS-8	E-6	Damage to containers from external event resulting in release of radiological material Location: Pit Storage Room Hazard Source: Radioactive Material	External fire (e.g., grass fire, truck at loading dock catches fire, electrical short or unknown ignition source).	I				
				I				
PS-9	E-6	Damage to containers from external event resulting in release of radiological material Location: Pit Storage Room Hazard Source: Radioactive Material	External explosion; explosive material being handled in nearby buildings is detonated and projects objects in the direction of 12-66.	U				
				I				

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Table C-1 Hazard Evaluation Table for SPSF Pit Storage Room, Unmitigated Consequences (page 4 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated				Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level		
PS-10	E-6	Damage to containers from external event resulting in release of radiological material Location: Pit Storage Room Hazard Source: Radioactive Material	External explosion; explosive material being transported on truck is detonated as truck passes in vicinity of SPSF; objects are projected in the direction of 12-66.	U	Temporary shutdown of the storage operation; potential for release of radiological material to the environment; contamination of pit storage room.	Worker: HIGH	4	
				I		Facility: MODERATE Offsite: HIGH	5 4*	
						The consequences of this event are bounded and represented by the consequences calculated for an impact event. * Requires Safety Class		
PS-11	E-6	Injury to personnel or facility damage due to external event Location: Pit Storage Room Hazard Source: Explosives in external facilities.	External explosion.	U	Temporary shutdown of the affected area.	Worker: HIGH	4	
				I		Facility: HIGH Offsite: NA	4 NA	
PS-12	E-6	Damage to containers from external event resulting in release of radiological material Location: Pit Storage Room Hazard Source: Radioactive Material	Surface vehicle impact	EU	Temporary shutdown of the affected area; potential for release of radiological material to the environment.	Worker: HIGH	7	
				I		Facility: HIGH Offsite: HIGH	7 7*	
						The consequences of this event are bounded and represented by the consequences calculated for an impact event. * Requires Safety Class		

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Table C-1 Hazard Evaluation Table for SPSF Pit Storage Room, Unmitigated Consequences (page 5 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
PS-13	E-6	Injury to personnel or facility damage due to external event Location: Pit Storage Room Hazard Source: Vehicles external to facility	Surface Vehicle impact (e.g., truck at dock, crane)	A	Temporary shutdown of the affected area.	Worker: HIGH	4
				1		Facility: MODERATE Offsite: NA	5 NA
PS-14	E-6	Damage to containers from external event resulting in release of radiological material Location: Pit Storage Room Hazard Source: Radioactive Material	Aircraft Impact	EU	Major damage to Pit Storage Room, its contents, and facilities in surrounding areas; major disruption of SPSF functions; event would likely involve a major portion of the pit containers in the storage room; radioactive releases from the containers involved would likely be high.	Worker: HIGH Facility: HIGH Offsite: HIGH	7 7 7*
				2		The consequences of this event are bounded and represented by the consequences calculated for an aircraft impact event. * Requires Safety Class	
PS-15	E-6	Injury to personnel or facility damage due to external event Location: Pit Storage Room Hazard Source: Vehicles external to facility	Aircraft impact	EU	Major damage to Pit Storage Room, its contents, and facilities in surrounding areas; major disruption of SPSF functions.	Worker: HIGH	7
				2		Facility: HIGH Offsite: NA	7 NA

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Table C-1 Hazard Evaluation Table for SPSF Pit Storage Room, Unmitigated Consequences (page 6 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Initiator Freq. Level	Unmitigated			Risk Bin Number
					Impact on Other Systems	Health and Safety Consequence Level		
PS-16	E-7	Release of radiological material due to NPH event Location: Pit Storage Room Hazard Source: Radioactive Material	Earthquake, tornado, high velocity straight winds	U	Temporary shutdown of the storage operation; potential for release of radiological material to the environment.	Worker: HIGH	4	
				3, 4		Facility: HIGH Offsite: HIGH		
PS-17	E-7	Damage to pit containers resulting in release of radiological material due to NPH Location: Pit Storage Room Hazard Source: Radioactive Material	Lightning	U	Potential for damage to electrical equipment.	Worker: MODERATE	5	
				5		Facility: MODERATE Offsite: HIGH		
PS-18	E-7	Radiological release due to NPH Location: Pit Storage Room Hazard Source: Radioactive Material	Heavy rain with accompanying leaks into building.	A	None	Worker: HIGH	1	
				5		Facility: MODERATE Offsite: HIGH		
						The consequences of this event are bounded and represented by the consequences calculated for an impact event.	* Requires Safety Class	
						The consequences of this event are bounded and represented by the consequences calculated for a small fire event.		
						The consequences of this event are bounded and represented by the consequences calculated for an impact event.	* Requires Safety Class	

3 DOE-STD-1020-94, Change Notice #1, January 1996 (Ref. 17)
4 Pantex Plant SAR, General Information Document (Ref. 18)
5 National Weather Service Data

Frequency information sources:
Engineering judgment/discussions with facility and material experts
DOE/EIS-225, Pantex EIS, November 1996 (Ref. 16)

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Table C-2. Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 1 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
LD-1	E-1	Radiological material release from pit containers due to fire on Loading dock Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Hydraulic fluid on AGV or forklift leaks; electrical short; unknown ignition source; battery charging station; worker error; combustibles on dock.	A	Shutdown of the affected area; potential for release of radiological material to the environment.	Worker: MODERATE Facility: MODERATE Offsite: HIGH	2
				1		The consequences of this event are bounded and represented by the consequences calculated for a large fire event.	2
				NA	NA	Worker: NA Facility: NA Offsite: NA	NA
LD-2	E-1	Pyrophoric material Location: Loading Dock Hazard Source: Radioactive Material	NA	NA			NA
				NA			NA
				NA			NA
LD-3	E-2	Radiological release from pit container due to an explosion on loading dock/ramp Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Hydrogen generated by batteries in AGV, shielded forklift, or at battery charging station; electrical short; ignition source on delivery truck; unknown ignition source	A	Potential for significant damage to equipment on loading dock; shutdown of the affected area; potential for release of radiological material to the environment	Worker: MODERATE Facility: MODERATE Offsite: HIGH	2
				1		The consequences of this event are bounded and represented by the consequences calculated for a large fire event.	2
				NA			1

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Table C-2 Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 2 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq Level	Impact on Other Systems	Health and Safety Consequence Level	
LD-4	E-3	Radiological release from pit container due to damage resulting from mishandling of pit container. Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Worker error; failure of computer control for AGV; containers are dropped, pushed over on dock, pushed from dock to ground, pierced or otherwise damaged with forklift tines.	A	Temporary shutdown of the affected area and the pit receiving operation; potential for release of radiological material to the environment; contamination of dock and ramp.	Worker: LOW Facility: LOW Offsite: LOW	3
				U	Potential for temporary shutdown of affected area and the pit receiving operation; potential for contamination to be spread to other areas including the environment.	Worker: LOW Facility: LOW Offsite: LOW	6
				I		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	
LD-5	E-3	Radiological release from pit container due to damage caused by object falling from ceiling Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Aging or corroding structures in ceiling (e.g., light fixtures, sprinkler piping, pipe hangers).	A			
				I			
LD-6	E-4	Personnel exposure due to leaking container Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Age of containers and pits, corrosion of pit shell; container overheating results in pit cracking; containers damaged during transportation to 12-66.	A	Temporary shutdown of affected area; potential for transference contamination to be spread to other areas.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE	11 13 12
				I			

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Table C-2 Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 3 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated				Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level		
LD-7	E-5	Criticality on dock. Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Forklift collides with several containers resulting in unfavorable configuration of pallets and containers; worker error; pallet failure; earthquake.	Insufficient inventory to have criticality event	NA	NA	NA	NA
LD-8	E-6	Radioactive Material release due to damage to pit containers resulting from electric vehicle collision with pallet on dock. Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Worker error; mechanical failure of vehicle.	A	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of dock and ramp.	Worker: LOW Facility: LOW Offsite: LOW The consequences of this event are bounded and represented by the consequences calculated for an impact event.	3 3 3	

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Table C-2 Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 4 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Initiator Freq. Level	Unmitigated			Risk Bin Number
					Impact on Other Systems	Health and Safety Consequence Level		
LD-9	E-6	Damage to containers on dock from external event resulting in release of radiological material Location: Loading Dock/Ramp Hazard Source: Radioactive Material	External fire (e.g., grass fire, truck at loading dock catches fire, chemicals temporarily staged on dock are ignited by electrical short or unknown ignition source).	A	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of dock and ramp.	Worker: MODERATE Facility: MODERATE Offsite: HIGH The consequences of this event are bounded and represented by the consequences calculated for a large fire event.	2	
				1			2	
				1			1	
LD-10	E-6	Damage to containers on dock from external event resulting in release of radiological material Location: Loading Dock/Ramp Hazard Source: Radioactive Material	External explosion (e.g., chemicals temporarily staged on dock react to heat, explosive material being handled in nearby buildings is detonated and projects objects in the direction of 12-66)	U	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of dock and ramp.	Worker: LOW Facility: LOW Offsite: LOW The consequences of this event are bounded and represented by the consequences calculated for an impact event.	6	
				1			6	
				1			6	

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Table C-2 Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 5 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Initiator Freq. Level	Unmitigated			Risk Bin Number
					Impact on Other Systems	Health and Safety Consequence Level		
LD-11	E-6	Damage to containers on dock from external event resulting in release of radiological material Location: Loading Dock/Ramp Hazard Source: Radioactive Material	External explosion; explosive material being transported on truck is detonated as truck passes in vicinity of SPSF and projects objects in the direction of 12-66.	U	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of dock and ramp.	Worker: LOW Facility: LOW Offsite: LOW	6	
				I		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	6	
							6	
LD-12	E-6	Injury to personnel or facility damage due to external event Location: Loading Dock/Ramp Hazard Source: Explosives in external facilities	External explosion.	U	Temporary shutdown of the affected area.	Worker: HIGH Facility: HIGH Offsite: NA	4	
				I			4	
							NA	
LD-13	E-6	Damage to containers on dock from external event resulting in release of radiological material Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Surface Vehicle impact (e.g., truck at dock, crane)	A	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of dock and ramp.	Worker: LOW Facility: LOW Offsite: LOW	3	
				I		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	3	
							3	

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Table C-2. Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 6 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated				Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level		
LD-14	E-6	Injury to personnel or facility damage due to external event Location: Loading Dock/Ramp Hazard Source: Vehicles external to facility	Surface Vehicle impact (e. g., truck at dock, crane)	A	Temporary shutdown of the affected area.	Worker: HIGH	4	
				1		Facility: MODERATE		
						Offsite: NA		
LD-15	E-6	Damage to containers on dock from external event resulting in release of radiological material Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Aircraft impact	EU	Potential for major damage to Loading Dock and equipment in room. Major disruption of support functions for storage facility.	Worker: HIGH	7	
				2		Facility: HIGH		
						Offsite: HIGH		
						The consequences of this event are bounded and represented by the consequences calculated for an aircraft impact event.	* Requires Safety Class	
LD-16	E-6	Injury to personnel or facility damage due to external event Location: Loading Dock/Ramp Hazard Source: Vehicles external to facility	Aircraft impact	EU	Potential for major damage to Loading Dock and equipment in room. Major disruption of support functions for storage facility.	Worker: HIGH	7	
				2		Facility: HIGH		
						Offsite: NA		

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Table C-2 Hazard Evaluation Table for SPSF Loading Dock/Ramp, Unmitigated Consequences (page 7 of 7)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
LD-17	E-7	Release of radiological material due to NPH event Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Earthquake, tornado, high velocity straight winds	U	Potential for damage to equipment on dock; radioactive material to environment	Worker: MODERATE Facility: LOW Offsite: LOW	5
				3, 4		The consequences of this event are bounded and represented by the consequences calculated for a large fire event.	6
							6
LD-18	E-7	Damage to pit containers resulting in release of radiological material due to NPH Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Lightning	U	Potential for damage to pit containers and release of radioactive material to environment;	Worker: MODERATE Facility: LOW Offsite: LOW	5
				5	potential for damage to electrical equipment on dock creating potential for subsequent fires.	The consequences of this event are bounded and represented by the consequences calculated for a large fire event.	6
							6
LD-19	E-7	Radiological release due to NPH Location: Loading Dock/Ramp Hazard Source: Radioactive Material	Heavy rain with accompanying leaks into building.	A	None	Worker: LOW Facility: LOW Offsite: LOW	3
				5		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	3
							3

Frequency information sources:
 1 Engineering judgment/discussions with facility and material experts
 2 DOE/EIS-225, Pantex EIS, November 1996 (Ref. 16)
 3 DOE-STD-1020-94, Change Notice #1, January 1996 (Ref. 17)
 4 Pantex Plant SAR, General Information Document (Ref. 18)
 5 National Weather Service Data

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Table C-3 Hazard Evaluation Table for SPSF Control Room, Unmitigated Consequences (page 1 of 3)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
CR-1	E-1	Room fire	Electrical equipment (office or computer equipment) overheats; Electrical short.	A	Damage to controls and monitoring system for AGV. Shutdown of operations in affected area; property damage.	Covered by NFPA and Performance Category, i.e., Common Hazardous Event.	NA
		Location: Control Room Hazard Source: Combustible Material					
CR-2	E-6	Personnel injured due to external event	External fire (e.g., grass fire, truck at loading dock catches fire, chemicals temporarily staged on dock are ignited by electrical short or unknown ignition source).	A	Damage to controls and monitoring system for AGV. Shutdown of operations in affected area; property damage.	Covered by NFPA, i.e., Common Hazardous Event.	NA
		Location: Control Room Hazard Source: Combustibles					
CR-3	E-6	Personnel injured due to external event	External explosion (e.g., explosive material being handled in nearby buildings is detonated and projects objects in the direction of 12-66)	U	Potential for damage to computer control equipment for AGV.	Worker: HIGH Facility: MODERATE Offsite: NA	4
		Location: Control Room Hazard Source: Explosives in external facilities		5			NA

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Table C-3 Hazard Evaluation Table for SPSF Control Room, Unmitigated Consequences (page 2 of 3)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
CR-4	E-6	Personnel injured due to external event	External explosion; explosive material being transported on truck is detonated as truck passes in vicinity of SPSF; objects are projected in the direction of 12-66.	U	Potential for damage to computer control equipment for AGV.	Worker: HIGH	4
		Location: Control Room		1		Facility: MODERATE	5
		Hazard Source: Explosives in external facilities			Offsite: NA	NA	
CR-5	E-6	Damage/injuries due to external event.	Surface vehicle impact.	EU	Potential for damage to computer control equipment for AGV.	Worker: HIGH	7
		Location: Control Room		1		Facility: MODERATE	8
		Hazard Source: Vehicles external to facility			Offsite: NA	NA	
CR-6	E-6	Damage/injuries due to external event.	Aircraft impact	EU	Potential for major damage to Control room structure and equipment in room. Major disruption of support functions for storage facility.	Worker: HIGH	7
		Location: Control Room		2		Facility: HIGH	7
		Hazard Source: Vehicles external to facility			Offsite: NA	NA	
CR-7	E-7	Equipment damage due to NPH	Heavy Rains	A	Potential for damage to equipment in room which could result in loss of support functions for storage facility.	Worker: NEGLIGIBLE	11
		Location: Control Room		5		Facility: LOW	3
		Hazard Source: NPH			Offsite: NA	NA	

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Table C-3 Hazard Evaluation Table for SPSF Control Room, Unmitigated Consequences (page 3 of 3)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
CR-8	E-7	Personnel injury due to NPH Location: Control Room Hazard Source: NPH	Earthquake, tornado, high velocity straight winds.	U 3, 4	Potential for disruption of services provided by equipment in room (e.g., HVAC)	Covered by Performance Category, i.e., Common Hazardous Event.	NA

Frequency information sources:

- 1 Engineering judgment/discussions with facility and material experts
- 2 DOE/EIS-225, Pantex EIS, November 1996 (Ref. 16)
- 3 DOE-STD-1020-94, Change Notice #1, January 1996 (Ref. 17)
- 4 Pantex Plant SAR, General Information Document (Ref. 18)
- 5 National Weather Service Data

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Table C-4. Hazard Evaluation Table for SPSF Interlock, Unmitigated Consequences (page 1 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
IN-1	E-1	Radiological material release from pit containers due to fire Location: Interlock Hazard Sources: Radioactive Material	Hydraulic fluid on AGV or forklift; Electrical short; unknown ignition source; worker error.	A	Shutdown of the affected area; potential for release of radiological material to the environment	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE	11 3 12
				1		The consequences of this event are bounded and represented by the consequences calculated for a small fire event.	
				NA	NA	Worker: NA Facility: NA Offsite: NA	NA
IN-2	E-1	Pyrophoric material Location: Interlock Hazard Source: Radioactive Material	NA	NA			
				NA			
				NA			
IN-3	E-2	Radiological release from pit container due to an explosion. Location: Interlock Hazard Source: Radioactive Material	Hydrogen generated by batteries in AGV, shielded forklift; electrical short; unknown ignition source.	A	Shutdown of the affected area; potential for release of radiological material to the environment.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE	11 3 12
				1		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	
				NA			

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Table C-4 Hazard Evaluation Table for SPSF Interlock, Unmitigated Consequences (page 2 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number	
				Initiator Freq Level	Impact on Other Systems	Health and Safety Consequence Level		
IN-4	E-3	Radiological release from pit container due to damage resulting from mishandling of pit container Location: Interlock Hazard Source: Radioactive Material	Worker error; failure of computer control for AGV; containers are dropped or pierced with forklift tines.	A	Temporary shutdown of the affected area; potential for release of radiological material to the environment; contamination of interlock.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for an impact event.	11 3 12	
				U	Potential for shutdown of affected area; potential for contamination to be spread to other areas including the environment.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for an impact event.	11 6 12	
				I				
IN-5	E-3	Radiological release from pit container due to damage caused by object falling from ceiling Location: Interlock Hazard Source: Radioactive Material	Aging or corroding structures in ceiling (e.g., light fixtures, sprinkler piping, pipe hangers).	A	Temporary shutdown of affected area; potential for transference of contamination to be spread to other areas.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for an oxidation event.	11 3 12	
				I				
IN-6	E-4	Personnel exposure due to leaking container Location: Interlock Hazard Source: Radioactive Material	Age of containers and pits, corrosion of pit shell; container overheating results in pit cracking; containers damaged during transportation to 12-66 (not detected on Loading Dock).	A	Temporary shutdown of affected area; potential for transference of contamination to be spread to other areas.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for an oxidation event.	11 3 12	
				I				

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Table C-4 Hazard Evaluation Table for SPSF Interlock, Unmitigated Consequences (page 3 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
IN-7	E-5	Criticality in Interlock. Location: Interlock Hazard Source: Radioactive Material	Forklift collides with and damages pallet resulting in unfavorable configuration of containers; earthquake.	Insufficient inventory to have criticality event	NA	NA	NA
IN-8	E-6	Damage to containers from external event resulting in release of radiological material Location: Interlock Hazard Source: Radioactive Material	External fire (e.g., grass fire, truck at loading dock catches fire).	A 1	Temporary shutdown of the affected area; potential for release of radiological material to the environment; potential for spread of contamination to other areas.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for a small fire event.	11 3 12
IN-9	E-6	Damage to containers from external event resulting in release of radiological material Location: Interlock Hazard Source: Radioactive Material	External explosion (e.g., explosive material being handled in nearby buildings is detonated and projects objects in the direction of 12-66)	U 1	Temporary shutdown of the affected area; potential for release of radiological material to the environment; potential for spread of contamination to other areas	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for an impact event.	11 6 12

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Table C-4 Hazard Evaluation Table for SPSF Interlock, Unmitigated Consequences (page 4 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
IN-10	E-6	Damage to containers from external event resulting in release of radiological material Location: Interlock Hazard Source: Radioactive Material	External explosion; explosive material being transported on truck is detonated as truck passes in vicinity of SPSF; objects are projected in the direction of 12-66.	U	Temporary shutdown of the affected area; potential for release of radiological material to the environment; potential for spread of contamination to other areas	Worker: NEGLIGIBLE	11
				I		Facility: LOW	6
						Offsite: NEGLIGIBLE	12
IN-11	E-6	Injury to personnel or facility damage due to external event Location: Interlock Hazard Source: Explosives in external facilities	External explosion.	U	Temporary shutdown of the affected area.	Worker: HIGH	4
				I		Facility: LOW	6
						Offsite: NA	NA
IN-12	E-6	Damage to containers from external event resulting in release of radiological material Location: Interlock Hazard Source: Radioactive Material	Aircraft impact	EU	Potential for major damage to interlock and equipment in room. Major disruption of support functions for storage facility; the event would likely involve significantly more material than the containers located only in the interlock.	Worker: HIGH	7
				2		Facility: HIGH	7
						Offsite: HIGH	7*
						The consequences of this event are bounded and represented by the consequences calculated for an aircraft impact event.	* Requires Safety Class

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Table C-4 Hazard Evaluation Table for SPSF Interlock, Unmitigated Consequences (page 5 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq Level	Impact on Other Systems	Health and Safety Consequence Level	
IN-13	E-6	Injury to personnel or facility damage due to external event Location: Interlock Hazard Source: Vehicles external to facility	Aircraft impact	EU	Potential for major damage to interlock and equipment in room. Major disruption of support functions for storage facility.	Worker: HIGH Facility: HIGH Offsite: NA	7
				2			7
							NA
IN-14	E-7	Release of radiological material due to NPH event Location: Interlock Hazard Source: Radioactive Material	Earthquake, tornado, high velocity straight winds	U	Temporary shutdown of the storage operation; potential for release of radiological material to the environment.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE	11
				3, 4		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	6
							12
IN-15	E-7	Damage to pit containers resulting in release of radiological material due to NPH Location: Interlock Hazard Source: Radioactive Material	Lightning	U	Potential for damage to electrical equipment.	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE	11
				5		The consequences of this event are bounded and represented by the consequences calculated for an impact event.	6
							12

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Table C-4. Hazard Evaluation Table for SPSF Interlock, Unmitigated Consequences (page 6 of 6)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
IN-16	E-7	Radiological release due to NPH Location: Interlock Hazard Source: Radioactive Material	Heavy rain with accompanying leaks into building.	A 5	None	Worker: NEGLIGIBLE Facility: LOW Offsite: NEGLIGIBLE The consequences of this event are bounded and represented by the consequences calculated for an impact event.	11 3 12

Frequency information sources:

- 1 Engineering judgment/discussions with facility and material experts
- 2 DOE/EIS-225, Pantex EIS, November 1996 (Ref. 16)
- 3 DOE-STD-1020-94, Change Notice #1, January 1996 (Ref. 17)
- 4 Pantex Plant SAR, General Information Document (Ref. 18)
- 5 National Weather Service Data

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Table C-5 Hazard Evaluation Table for SPSF Equipment Room, Unmitigated Consequences (page 1 of 4)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq Level	Impact on Other Systems	Health and Safety Consequence Level	
ER-1	E-1	Injuries due to fire confined to room. Location: Equipment Room Hazard Source: Combustible Material	Combustible materials; oil in reservoir on air compressor; electrical short; unknown ignition source; earthquake.	A	Potential for damage to equipment in room which could result in shutdown of Bldg. support systems (e.g., HVAC system).	Covered by NPPA, i.e., Common Hazardous Event	NA
				I			
ER-2	E-2	Injuries, equipment damage due to steam line failure Location: Equipment Room Hazard Source: Steam	Water hammer; corrosion	A	None	Worker: HIGH	1
				I		Facility: LOW Offsite: NA	3 NA
ER-3	E-2	Injuries due to switchgear failure or explosion Location: Equipment Room Hazard Source: Electrical Equipment	Electrical short; aged power cable insulation; lightening results in arcing in switchgear.	A	Potential for damage to equipment in room which could result in shutdown of Bldg. Support systems (e.g., HVAC system).	Covered by NEC, i.e., Common Hazardous Event.	NA
				I			
ER-4	E-2	Injuries due to battery explosion Location: Equipment Room Hazard Source: Batteries	Hydrogen generated by lead acid batteries; electrical equipment failure; misc. activities near batteries cause spark.	A	Potential for damage to equipment in room which could result in shutdown of Bldg. support systems (e.g., HVAC system).	Worker: MODERATE	2
				I		Facility: LOW Offsite: NA	3 NA

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Table C-5 Hazard Evaluation Table for SPSF Equipment Room, Unmitigated Consequences (page 2 of 4)

Event No.	Event Category	Postulated Event Description	Causes	Initiator Freq. Level	Unmitigated			Risk Bin Number
					Impact on Other Systems	Health and Safety Consequence Level		
ER-5	E-4	Exposure to contamination circulated through HVAC system from Pit Storage room Location: Equipment Room Hazard Source: Radioactive Contamination	Leaking ductwork; External event.	U I	None	The consequences to onsite workers and the facility are covered by the consequences given for Event PS-6.	NA	
ER-6	E-6	Damage/injuries due to external event. Location: Equipment Room Hazard Source: Fires external to facility	External fire (e.g., grass fire, vehicle in vicinity catches fire).	A I	Temporary shutdown of the affected area; potential for damage to equipment in room.	Covered by NFPA; i.e., Common Hazardous Event	NA	
ER-7	E-6	Damage/injuries due to external event. Location: Equipment Room Hazard Source: Explosives	External explosion (e.g., material being handled in nearby buildings is detonated and projects objects in the direction of 12-66)	U I	Potential for damage to equipment in room which could result in shutdown of Bldg. support systems (e.g., HVAC system).	Worker: HIGH Facility: MODERATE Offsite: NA	4 5 NA	

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Table C-5 Hazard Evaluation Table for SPSF Equipment Room, Unmitigated Consequences (page 3 of 4)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq. Level	Impact on Other Systems	Health and Safety Consequence Level	
ER-8	E-6	Damage/injuries due to external event. Location: Equipment Room Hazard Source: Explosives	External explosion; explosive material being transported on truck is detonated as truck passes in vicinity of SPSF; objects are projected in the direction of 12-66.	U	Potential for damage to equipment in room which could result in shutdown of Bldg. support systems (e.g., HVAC system).	Worker: HIGH Facility: MODERATE Offsite: NA	4
				I			5
				NA			NA
ER-9	E-6	Damage/injuries due to external event. Location: Equipment Room Hazard Source:	Surface vehicle, crane impact.	U	Potential for damage to equipment in room which could result in shutdown of Bldg. support systems (e.g., HVAC system).	Worker: HIGH Facility: LOW Offsite: NA	4
				I			6
				NA			NA
ER-10	E-6	Damage/injuries due to external event. Location: Equipment Room Hazard Source:	Aircraft impact.	EU	Potential for major damage to equipment in room and equipment in room. Major disruption of support functions for storage facility.	Worker: HIGH Facility: HIGH Offsite: NA	7
				2			7
				NA			NA
ER-11	E-7	Equipment damage due to flooding Location: Equipment Room Hazard Source:	Heavy Rains	A	Potential for damage to equipment in room which could result in loss of support functions for storage facility.	Worker: NEGLIGIBLE Facility: NEGLIGIBLE Offsite: NA	11
				5			11
				NA			NA

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Table C-5 Hazard Evaluation Table for SPSF Equipment Room, Unmitigated Consequences (page 4 of 4)

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated			Risk Bin Number
				Initiator Freq Level	Impact on Other Systems	Health and Safety Consequence Level	
ER-12	E-7	Injuries due to NPH Location: Equipment Room Hazard Source: NPH	Earthquake, tornado, high velocity straight winds.	U 5	Potential for disruption of services provided by equipment in room (e.g. HVAC)	Covered by Performance Category; i.e., Common Hazardous Event.	NA

Frequency information sources:

- 1 Engineering judgment/discussions with facility and material experts
- 2 DOE/EIS-225, Pantex EIS, November 1996 (Ref. 16)
- 3 DOE-STD-1020-94, Change Notice #1, January 1996 (Ref. 17)
- 4 Pantex Plant SAR, General Information Document (Ref. 18)
- 5 National Weather Service Data

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APPENDIX D - CONSEQUENCE DETERMINATION

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The following information describes the models developed to characterize the five representative events used to bound the events listed in the Hazard Evaluation Tables (Appendix C). In addition, this information shows the calculations performed to generate the onsite and offsite release values for each representative vent. For purposes of these calculations, no credit is taken for the pit cladding or for the drum in which the pit is stored (an unmitigated release is assumed).

Representative Event Scenario 1: Large Fire (Loading Dock only)

- Caused by ignition of combustibles on dock
- Assumes 36 pits exposed to 1000°C for 1 hour
- Then, all 36 pits are exposed to 200°C for 24 hours
- Then, all 36 pits are exposed to 20°C for 4 days

@ 1000°C -

Use 30 minute value (conservative) from Table D-2,

Onsite - 4.6E+03 Offsite - 1.6E+02

Release (from Table D-1): $(7.1E-04) \times 4 = 1.8E-04$ (for 1 hour)

@ 200°C -

Use 1 hour value from Table D-2,

Onsite - 4.0E+03 Offsite - 1.4E+02

Release (from Table D-1): 8.5E-07 (for a 24 hour period)

@ 20°C -

Use 1 hour value (conservative) from Table D-2,

Onsite - 4.0E+03 Offsite - 1.4E+02

Release (from Table D-1): 3.4E-07 (for a 96 hour period)

Onsite: $36(1.8E-04)(4.6E+03) + 36(8.5E-07)(4.0E+03) + 36(3.4E-07)(4.0E+03) = 30 \text{ rem}$

Offsite: $36(1.8E-04)(1.6E+02) + 36(8.5E-07)(1.4E+02) + 36(3.4E-07)(1.4E+02) = 1.05 \text{ rem}$

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Representative Event Scenario 2: Small Fire (Pit Storage Room, Interlock, and Loading Dock)

- Caused by fire on forklift
- Assumes 6 pits on the forklift exposed to 600°C for 1 hour
- Then, all 6 pits are exposed to 200°C for 24 hours
- Then, all 6 pits are exposed to 20°C for 4 days

For remainder of pits in section (30 on dock/12038 in Pit Storage Room):

- Assumes remaining pits are exposed to 200°C for 24 hours
- Then, remaining pits are exposed to 20°C for 4 days

@ 600°C -

Use 30 minute value (conservative) from Table D-2,

Onsite - 4.6E+03 Offsite - 1.6E+02

Release (from Table D-1): $(2.1E-04) + 12 = 1.75E-05$ (for 1 hour)

@ 200°C -

Use 1 hour value from Table D-2,

Onsite - 4.0E+03 Offsite - 1.4E+02

Release (from Table D-1): $8.5E-07$ (for a 24 hour period)

@ 20°C -

Use 1 hour value (conservative) from Table D-2,

Onsite - 4.0E+03 Offsite - 1.4E+02

Release (from Table D-1): $3.4E-07$ (for a 96 hour period)

Onsite:

Interlock - One Pallet (6 pits) only

$6(1.75E-05)(4.6E+03) + 6(8.5E-07)(4.0E+03) + 6(3.4E-07)(4.0E+03) = \underline{0.51 \text{ rem}}$

Dock - Pallet (6 pits) on forklift + 30 additional pits on dock

$0.51 + 30(8.5E-07)(4.0E+03) + 30(3.4E-07)(4.0E+03) = \underline{0.65 \text{ rem}}$

Pit Storage Room - Pallet (6 pits) + 12038 additional pits in room

$0.51 + 12038(8.5E-07)(4.0E+03) + 12038(3.4E-07)(4.0E+03) = \underline{57.81 \text{ rem}}$

Offsite:

Interlock - One Pallet (6 pits) only

$6(1.75E-05)(1.6E+02) + 6(8.5E-07)(1.4E+02) + 6(3.4E-07)(1.4E+02) = \underline{0.02 \text{ rem}}$

Dock - Pallet (6 pits) on forklift + 30 additional pits on dock

$0.02 + 30(8.5E-07)(1.4E+02) + 30(3.4E-07)(1.4E+02) = \underline{0.03 \text{ rem}}$

Pit Storage Room - Pallet (6 pits) + 12038 additional pits in room

$0.02 + 12038(8.5E-07)(1.4E+02) + 12038(3.4E-07)(1.4E+02) = \underline{2.02 \text{ rem}}$

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Representative Event Scenario 3: Oxidation followed by impact

- Caused by mishandling, seismic event, external event
- Assumes all pits in area are impacted

Use 1 hour value from Table D-2,
Onsite - $4.0E+03$ Offsite - $1.4E+02$
Release (from Table D-1): $3.2E-05$ (for a 96 hour period)

Onsite:

Interlock: $6(3.2E-05)(4E+03) = 0.76 \text{ rem}$

Dock: $36(3.2E-05)(4E+03) = 4.6 \text{ rem}$

Pit Storage Room: $12044(3.2E-05)(4E+03) = 1542 \text{ rem}$

Offsite:

Interlock: $6(3.2E-05)(1.4E+02) = 0.03 \text{ rem}$

Dock: $36(3.2E-05)(1.4E+02) = 0.16 \text{ rem}$

Pit Storage Room: $12044(3.2E-05)(1.4E+02) = 53.96 \text{ rem}$

Representative Event Scenario 4: Oxidation

- Caused by exposure of pits to ambient conditions
- Assumes all pits in area are impacted

Use 1 hour values from Table D-2,
Onsite - $4.0E+03$ Offsite - $1.4E+02$
Release (from Table D-1): $(3.4E-07) \div 4 = 8.5E-08$ per day

Onsite:

Interlock: $6(8.5E-08)(4E+03) = 0.002 \text{ rem/day} = 0.74 \text{ rem/yr}$

Dock: $36(8.5E-08)(4E+03) = 0.01 \text{ rem/day} = 4.5 \text{ rem/yr}$

Pit Storage Room: $12044(8.5E-08)(4E+03) = 4.1 \text{ rem/day} = 1495 \text{ rem/yr}$

Offsite:

Interlock: $6(8.5E-08)(1.4E+02) = 7.1E-05 \text{ rem/day} = 0.26 \text{ rem/yr}$

Dock: $36(8.5E-08)(1.4E+02) = 4.3E-04 \text{ rem/day} = 1.56 \text{ rem/yr}$

Pit Storage Room: $12044(8.5E-08)(1.4E+02) = 0.14 \text{ rem/day} = 52.3 \text{ rem/yr}$

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Representative Event Scenario 5: Aircraft Imp

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- Assumes all pits in area are impacted
- Assumes jet fuel fire affects all the material in each pit

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(b)(3)

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Table D-1 Material Released Per Pit

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Table D-2 CEDE Values for Ground Level Release of 1 kg of Pu-239

Release Period	CEDE (Rem)	
	100m (Onsite) ¹	1.45km (Offsite) ¹
3 min	7.0E+03	2.6E+02
30 min	4.6E+03	1.6E+02
1 hour	4.0E+03	1.4E+02

The values for the onsite worker are reported for the 50th quantile dose level without regard to sector. The values for the maximally exposed offsite individual are reported for the 95th quantile dose level without regard to sector. All values include the effects of dry deposition.

¹ Values from Ref. 14

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Table D-3 Summary of Consequences for Representative Events

Event	Location	Consequences (Rem)	
		Onsite	Offsite
Large Fire	Loading Dock	30	1.05
Small Fire	Interlock	0.51	0.02
	Loading Dock	0.65	0.03
	Pit Storage Room	57.81	2.02
Oxidation/Impact	Interlock	0.76	0.03
	Loading Dock	4.6	0.16
	Pit Storage Room	1542	53.96
Oxidation	Interlock	0.002/day, 0.74/yr	<0.001/day, 0.26/yr
	Loading Dock	0.01/day, 4.5/yr	0.00043/day, 1.56/yr
	Pit Storage Room	4.1/day, 1495/yr	0.14/day, 52.3/yr
Aircraft Impact	Interlock	2,730	101.4
	Loading Dock	16,380	608.4
	Pit Storage Room	5.48E+06	2.04E+05

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